JP,11-032237,A
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3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] A straight-line approximation means to approximate a gamma characteristic curve in two or more straight lines, and a multiplier decision means to determine each multiplier of the primary type which expresses said approximated straight line in each, A calculation means to ask for said approximated ream contact position of an adjoining straight line, and a distinction means to distinguish whether the inputted video-signal level supports which straight line of said approximated straight line, Gamma correction equipment characterized by providing an operation means to change said video-signal level based on said distinguished straight line.
[Claim 2] A straight-line approximation means to approximate a division means to divide a gamma characteristic curve into two or more fields, and said divided gamma characteristic curve of a field, in the straight line connected on the boundary of an adjoining field, A multiplier decision means to determine each multiplier of the primary type which expresses said approximated straight line in each, Gamma correction equipment characterized by providing a distinction means to distinguish whether the inputted video-signal level supports which field of said divided field, and an operation means to change said video-signal level based on the straight line approximated to said distinguished gamma characteristic curve of a field.
[Claim 3] Gamma correction equipment according to claim 2 characterized by constituting said division means to divide a gamma characteristic curve into two or more fields so that a setup of a division location can be performed by external actuation.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention is used for gamma corrections, such as a liquid crystal panel which has a steep gamma characteristic curve especially, about gamma correction equipment, and relates to suitable gamma correction equipment.
[0002]
[Description of the Prior Art] A liquid crystal panel with little power consumption is briskly used increasingly as a display with a thin shape with the miniaturization of electronic equipment in recent years, carrying-izing, etc. In order to have the very steep gamma property from the property and to display an image in the good condition visually, after a liquid crystal panel performs the gamma correction which carries out the

level conversion of the input signal according to the input level, it is inputted into the liquid crystal panel.
[0003] There is the approach of amplifying and amending with the amplification factor according to input voltage in this gamma correction using the analog amplifier of BAIPORA. In this case, it is required to enlarge the amplification factor of amplifier to the display device which has the steep gamma property like a liquid crystal panel. However, generally, when analog amplifier increased the amplification factor, it was difficult to secure sufficient amplification factor for amending this to a very steep gamma property and with frequency characteristics and aggravation of a S/N ratio.
[0004] Moreover, the approach using the translation table which made the output level to an input level memorize is in a storage element, for example, RAM, as other approaches of a gamma correction. However, the translation table needed to be created for every property of a display device in this case, and the storage area was to be occupied greatly.
[0005]
[Problem(s) to be Solved by the Invention] Therefore, this invention aims at offer of the gamma correction equipment which can express gradation more correctly to the display device which has the steep gamma property, without producing frequency characteristics and aggravation of a S/N ratio, and can set up the gamma correction curve of arbitration easily.
[0006]
[Means for Solving the Problem] A straight-line approximation means to approximate a gamma characteristic curve in two or more straight lines according to the publication of claim 1, A multiplier decision means to determine each multiplier of the primary type which expresses said approximated straight line in each, A calculation means to ask for said approximated ream contact position of an adjoining straight line, and a distinction means to distinguish whether the inputted video-signal level supports which straight line of said approximated straight line, The gamma correction equipment possessing an operation means to change said video-signal level based on said distinguished straight line is constituted.
[0007] By this configuration, a gamma correction curve can be approximated in two or more straight lines, a video signal can be amplified with a high amplification factor by the operation by digital one, and a gamma correction can be correctly carried out corresponding to the display device which has a steep gamma property. Moreover, after digital signal processing, since it returns to an analog signal, it becomes possible to prevent that the frequency characteristics and S/N by the gamma correction get worse.
[0008] A division means to divide a gamma characteristic curve into two or more fields according to the publication of claim 2, A straight-line approximation means to approximate in the straight line which connects the gamma characteristic curve of said divided field on the boundary of an adjoining field, A multiplier decision means to determine each multiplier of the primary type which expresses said approximated straight line in each, The inputted video-signal level constitutes the gamma correction equipment possessing a distinction means to distinguish whether which field of said divided field is supported, and an operation means to change said video-signal level based on the straight line approximated to said distinguished gamma characteristic curve of a field.
[0009] By this configuration, it approximates in a straight line for every field which divided the gamma correction curve, and a video signal can be amplified with a high

amplification factor by the operation by digital one, and a gamma correction can be correctly carried out corresponding to the display device which has a steep gamma property. Moreover, after digital signal processing, since it returns to an analog signal, it becomes possible to prevent that the frequency characteristics and S/N by the gamma correction get worse.

[0010] According to the publication of claim 3, in gamma correction equipment according to claim 2, a division means to divide a gamma characteristic curve into two or more fields is constituted so that a setup of a division location can be performed by external actuation.

[0011] It becomes possible to divide a gamma characteristic curve into the field of arbitration by external actuation.

[0012]

[Embodiment of the Invention] The gestalt of operation of this invention is explained with reference to drawing 1 thru/or drawing 5 . Drawing 1 is drawing showing the applied voltage of a liquid crystal panel, and the relation of light transmittance, and drawing 2 is drawing showing electrical-potential-difference conversion of the input signal with which the light transmittance of a liquid crystal panel becomes linear. Drawing 3 is drawing for explaining straight-line approximation of the gamma correction concerning this invention. Moreover, drawing 4 is drawing of the system configuration of an involving-in this invention gamma correction, and drawing 5 is drawing showing the configuration of the gamma correction section. In addition, although aimed at the liquid crystal panel as a display device in the following explanation, naturally this invention may be applied to other display devices.

[0013] The applied voltage of a liquid crystal panel and the relation of light transmittance have the gamma property that change of light transmittance consists of a loose part and a steep part to applied voltage, as shown in the continuous line of drawing 1 . An unnatural image will be displayed when a video signal is inputted into such a gamma property as it is.

[0014] Now, it is going to carry out image display which rode on the broken line of drawing 1 linear to applied voltage under this gamma property. First, T1 When it is going to obtain permeability, it is V1 on a broken line. An electrical potential difference is V1 ' on a continuous line... It is Vn. It becomes Vn '. That is, a linear display can carry out to an original video signal by electrical-potential-difference conversion accomplishing so that it may become the output signal of an axis of ordinate to the input signal of an axis of abscissa as shown in drawing 2 , and inputting into the liquid crystal panel which has the gamma property which mentioned above this changed electrical potential difference.

[0015] Analog amplifier and a translation table are used conventionally, the level conversion of this input signal is performed, and it also just already described that problem. In addition, the broken line of the viewpoint of visual effectiveness to drawing 1 may be a curve which can perform moderate conversion.

[0016] In this invention, as shown in drawing 3 , the conversion curve (a "gamma correction curve" is called hereafter) of drawing 2 tends to be approximated in some straight lines, tends to be calculated based on this straight line, and it is going to change this conversion. Connecting each straight line on the boundary of an adjoining field is determined. In addition, this straight line may be automatically determined that an error will serve as min within the specified straight-line number as compared with a gamma

property by the operation, and may determine the optimal straight line for every divided field by external directions.
[0017] Below, the property of this approximated straight line is explained. For example, for a gamma correction curve, an input signal is 0-a1 as shown in drawing 3 . a1 -an It shall approximate in three straight lines of an -1023. 1023 shows that the input signal was divided by the regular intervals of 1023 here, and it is not limited to especially this numeric value. The same is said of 1023 of output voltage.
[0018] the conversion by these straight lines -- an input signal 0 -- receiving -- output voltage -- 0 -- it is -- an input signal a1 -- receiving -- output voltage -- b1 it is -- input signal an receiving -- output voltage -- bn it is -- to an input signal 1023, since output voltage is 1023, each straight line can be expressed with the following formula (1), a formula (2), and a formula (3) in order.
Y=b1 / a1 xX (1)
Y=(b2-b1)/(a2-a1) x(X-a1)+b1 (2)
Y=(1023-b2)/(1023-a2) x(X-a2)+b2 (3)
Generally these formulas are expressed with a formula (4).
Y=AxX+B (4)
[0019] Therefore, the coefficient A in each field and B can be determined, the input signal of the field can be substituted for X of the formula of the straight line of the field, and the signal over the input signal by which the gamma correction was carried out can be acquired by asking for Y. In addition, although the gamma correction curve was approximated in three straight lines here, it does not restrict to especially three.
[0020] Below, the example of an operation gestalt of the system configuration of a gamma correction is explained with reference to drawing 4 . This example of an operation gestalt changes a video signal into a digital signal, and performs the gamma correction mentioned above by data processing. Although this drawing shows one color of a color signal, processing same about other colors is performed.
[0021] After a video signal is changed into a 8-bit digital signal by A/D converter 1, it is inputted into the digital signal driver (DSD) 2. The inputted digital signal performs the gamma correction by the digital operation in the gamma correction section 5, after being adjusted, respectively by the gain controller 3 of the digital signal driver 2 interior, and the bright controller 4. Then, it is outputted as a 10-bit digital signal after adjustment by the limiter controller 6 and the black frame controller 7. The multiplier used in each processing section at this time is inputted as serial data from the digital signal driver 2 exterior, and is set up through serial I/F 8, and the counter/decoder 9.
[0022] After the 10-bit digital signal outputted from the digital signal driver 2 is changed into an analog signal by D/A converter 10, performs magnification and a reversal process with an analog amplifier 11 and performs a sample / hold processing, it is inputted into a liquid crystal panel 12, and displays an image.
[0023] As explained above, a video signal is displayed as an image which the gamma correction which was suitable for the liquid crystal panel with a digital operation was made, and was excellent in the vision target. In addition, in this system, all timing control is performed from a timing generator 13, and a setup of serial data is performed from a microcomputer (not shown). Moreover, the number of bits of I/O of the digital signal driver 2 and especially the number of the signal line between an analog amplifier 11 and a liquid crystal panel 12, i.e., the signal-line number of a liquid crystal panel 12, are not

limited to the number mentioned above.
[0024] Below, the configuration of the gamma correction section 5 is explained with reference to drawing 5 . This configuration consists of selector block 20 which chooses the coefficient A of a formula (4), and B according to the level of the inputted video signal, and operation block 30 which inputs a video signal, a coefficient A, and B and calculates a formula (4). In addition, at this invention, the number of bits of an operation is the coefficient C 1 as which 8 bits and a coefficient A are inputted by 6 bits, and a coefficient B is inputted into it for an input signal by 10 bits and the comparator 21. And coefficient C 2 inputted into a comparator 22 Although 8 bits and an output signal were respectively made into 10 bits, it does not limit to especially these.
[0025] First, the configuration and actuation of the selector block 20 are explained. By the selector block 20 which chooses the multiplier corresponding to an input signal, they are an input signal and a coefficient C 1. To a comparator 21, they are an input signal and a coefficient C 2. It is inputted into a comparator 22. This coefficient C 1 and C2 a1 in a formula (1) - a formula (3), and a2 It is equivalent to 8 bits of high orders. With comparators 21 and 22, they are an input signal, each coefficient C 1, and C2. It compares and they are X>=C1 and X>=C2. A flag signal "1" is outputted to a case, respectively, and "0" is outputted except it. the outputted signal -- respectively -- a 1-bit flip-flop (FF) -- it lets 23 and 24 pass and is inputted into decoders 25 and 26.
[0026] And when the output of LSB and a comparator 22 is considered for the output of a comparator 21 as MSB, It sets with the decoder 25 which chooses a coefficient A, and the decoder 26 which chooses a coefficient B. if the signal of the flip-flops 23 and 24 inputted is "00" -- a coefficient A 1 and B1 If it is "01", they are a coefficient A 2 and B-2. If it is "11", it is multiplier A3 and B3. After being chosen and preparing data with flip-flops 27 and 28, it is sent to the operation block 30.
[0027] Below, the configuration and actuation of the operation block 30 are explained. The input signal with which a gain adjustment and bright adjustment were performed is inputted into a multiplier 33 through the flip-flops 31 and 32 of 8 bit patterns. Moreover, the coefficient A chosen with the selector block 20 is also inputted into a multiplier 33. It is for doubling the number of stages of processing with the coefficient A of the selector block 20 with which letting two steps of flip-flops 31 and 32 pass is inputted into a multiplier 33 in an input signal.
[0028] And 4 bits of low order are omitted among 14 bits of the result of an operation, and 10 bits of high orders are outputted. For example, when a multiplier called A=01 0000 is set up, it becomes Y=AxX+B=X+B from a formula (4). Namely, 2 bits of high orders of a coefficient A will express one or more figures, 4 bits of low order will express less than one figure, and, as for a formula (4), an inclination can also express one or less straight line. After this result of an operation passes a flip-flop 34, it is inputted into an adder 35.
[0029] On the other hand, it is inputted into an adder 35 after the coefficient B chosen with the selector block 20 also passes a flip-flop 36. A flip-flop 36 is for making the timing in an adder 35 agree. The signal inputted into the adder 35 performs 10-bit +10-bit addition, and outputs ten of 11 bits of the result of an operation of low order. Then, it outputs to the limiter controller 6 shown in drawing 4 through a flip-flop 37, and as mentioned above, subsequent signal processing is performed and the signal by which the gamma correction was carried out is supplied to a liquid crystal panel. Graphic display

which was visually excellent by this is realized.
[0030]
[Effect of the Invention] Since a video signal can be amplified with a high amplification factor by the operation by digital one according to the gamma correction equipment of this invention so that clearly from the above explanation, the gradation of a video signal can be expressed more correctly. Moreover, after digital signal processing, since it returns to an analog signal, it becomes possible to prevent that the frequency characteristics and S/N by the gamma correction get worse. Furthermore, since the multiplier of the operation by digital one can be set as arbitration from the exterior, it is possible to apply to the liquid crystal panel of various properties.
TECHNICAL FIELD

[Field of the Invention] This invention is used for gamma corrections, such as a liquid crystal panel which has a steep gamma characteristic curve especially, about gamma correction equipment, and relates to suitable gamma correction equipment.
PRIOR ART

[Description of the Prior Art] A liquid crystal panel with little power consumption is briskly used increasingly as a display with a thin shape with the miniaturization of electronic equipment in recent years, carrying-izing, etc. In order to have the very steep gamma property from the property and to display an image in the good condition visually, after a liquid crystal panel performs the gamma correction which carries out the level conversion of the input signal according to the input level, it is inputted into the liquid crystal panel.
[0003] There is the approach of amplifying and amending with the amplification factor according to input voltage in this gamma correction using the analog amplifier of BAIPORA. In this case, it is required to enlarge the amplification factor of amplifier to the display device which has the steep gamma property like a liquid crystal panel. However, generally, when analog amplifier increased the amplification factor, it was difficult to secure sufficient amplification factor for amending this to a very steep gamma property and with frequency characteristics and aggravation of a S/N ratio.
[0004] Moreover, the approach using the translation table which made the output level to an input level memorize is in a storage element, for example, RAM, as other approaches of a gamma correction. However, the translation table needed to be created for every property of a display device in this case, and the storage area was to be occupied greatly.
EFFECT OF THE INVENTION

[Effect of the Invention] Since a video signal can be amplified with a high amplification factor by the operation by digital one according to the gamma correction equipment of this invention so that clearly from the above explanation, the gradation of a video signal can be expressed more correctly. Moreover, after digital signal processing, since it returns to an analog signal, it becomes possible to prevent that the frequency characteristics and S/N by the gamma correction get worse. Furthermore, since the multiplier of the operation by digital one can be set as arbitration from the exterior, it is possible to apply to the liquid crystal panel of various properties.
TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Therefore, this invention aims at offer of the gamma correction equipment which can express gradation more correctly to the display device which has the steep gamma property, without producing frequency characteristics and aggravation of a S/N ratio, and can set up the gamma correction curve of arbitration easily.

MEANS

[Means for Solving the Problem] A straight-line approximation means to approximate a gamma characteristic curve in two or more straight lines according to the publication of claim 1, A multiplier decision means to determine each multiplier of the primary type which expresses said approximated straight line in each, A calculation means to ask for said approximated ream contact position of an adjoining straight line, and a distinction means to distinguish whether the inputted video-signal level supports which straight line of said approximated straight line, The gamma correction equipment possessing an operation means to change said video-signal level based on said distinguished straight line is constituted.

[0007] By this configuration, a gamma correction curve can be approximated in two or more straight lines, a video signal can be amplified with a high amplification factor by the operation by digital one, and a gamma correction can be correctly carried out corresponding to the display device which has a steep gamma property. Moreover, after digital signal processing, since it returns to an analog signal, it becomes possible to prevent that the frequency characteristics and S/N by the gamma correction get worse.

[0008] A division means to divide a gamma characteristic curve into two or more fields according to the publication of claim 2, A straight-line approximation means to approximate in the straight line which connects the gamma characteristic curve of said divided field on the boundary of an adjoining field, A multiplier decision means to determine each multiplier of the primary type which expresses said approximated straight line in each, The inputted video-signal level constitutes the gamma correction equipment possessing a distinction means to distinguish whether which field of said divided field is supported, and an operation means to change said video-signal level based on the straight line approximated to said distinguished gamma characteristic curve of a field.

[0009] By this configuration, it approximates in a straight line for every field which divided the gamma correction curve, and a video signal can be amplified with a high amplification factor by the operation by digital one, and a gamma correction can be correctly carried out corresponding to the display device which has a steep gamma property. Moreover, after digital signal processing, since it returns to an analog signal, it becomes possible to prevent that the frequency characteristics and S/N by the gamma correction get worse.

[0010] According to the publication of claim 3, in gamma correction equipment according to claim 2, a division means to divide a gamma characteristic curve into two or more fields is constituted so that a setup of a division location can be performed by external actuation.

[0011] It becomes possible to divide a gamma characteristic curve into the field of arbitration by external actuation.

[0012]

[Embodiment of the Invention] The gestalt of operation of this invention is explained with reference to drawing 1 thru/or drawing 5 . Drawing 1 is drawing showing the applied voltage of a liquid crystal panel, and the relation of light transmittance, and drawing 2 is drawing showing electrical-potential-difference conversion of the input signal with which the light transmittance of a liquid crystal panel becomes linear. Drawing 3 is drawing for explaining straight-line approximation of the gamma correction concerning this invention. Moreover, drawing 4 is drawing of the system configuration of an involving-in this invention gamma correction, and drawing 5 is drawing showing the configuration of the gamma correction section. In addition, although aimed at the liquid crystal panel as a display device in the following explanation, naturally this invention may be applied to other display devices.

[0013] The applied voltage of a liquid crystal panel and the relation of light transmittance have the gamma property that change of light transmittance consists of a loose part and a steep part to applied voltage, as shown in the continuous line of drawing 1 . An unnatural image will be displayed when a video signal is inputted into such a gamma property as it is.

[0014] Now, it is going to carry out image display which rode on the broken line of drawing 1 linear to applied voltage under this gamma property. First, T1 When it is going to obtain permeability, it is V1 on a broken line. An electrical potential difference is V1 ' on a continuous line... It is Vn. It becomes Vn '. That is, a linear display can carry out to an original video signal by electrical-potential-difference conversion accomplishing so that it may become the output signal of an axis of ordinate to the input signal of an axis of abscissa as shown in drawing 2 , and inputting into the liquid crystal panel which has the gamma property which mentioned above this changed electrical potential difference.

[0015] Analog amplifier and a translation table are used conventionally, the level conversion of this input signal is performed, and it also just already described that problem. In addition, the broken line of the viewpoint of visual effectiveness to drawing 1 may be a curve which can perform moderate conversion.

[0016] In this invention, as shown in drawing 3 , the conversion curve (a "gamma correction curve" is called hereafter) of drawing 2 tends to be approximated in some straight lines, tends to be calculated based on this straight line, and it is going to change this conversion. Connecting each straight line on the boundary of an adjoining field is determined. In addition, this straight line may be automatically determined that an error will serve as min within the specified straight-line number as compared with a gamma property by the operation, and may determine the optimal straight line for every divided field by external directions.

[0017] Below, the property of this approximated straight line is explained. For example, for a gamma correction curve, an input signal is 0-a1 as shown in drawing 3 . a1 -an It shall approximate in three straight lines of an -1023. 1023 shows that the input signal was divided by the regular intervals of 1023 here, and it is not limited to especially this numeric value. The same is said of 1023 of output voltage.

[0018] the conversion by these straight lines -- an input signal 0 -- receiving -- output voltage -- 0 -- it is -- an input signal a1 -- receiving -- output voltage -- b1 it is -- input signal an receiving -- output voltage -- bn it is -- to an input signal 1023, since output voltage is 1023, each straight line can be expressed with the following formula (1), a formula (2), and a formula (3) in order.

Y=b1 / a1 xX (1)
Y=(b2-b1)/(a2-a1) x(X-a1)+b1 (2)
Y=(1023-b2)/(1023-a2) x(X-a2)+b2 (3)
Generally these formulas are expressed with a formula (4).
Y=AxX+B (4)
[0019] Therefore, the coefficient A in each field and B can be determined, the input signal of the field can be substituted for X of the formula of the straight line of the field, and the signal over the input signal by which the gamma correction was carried out can be acquired by asking for Y. In addition, although the gamma correction curve was approximated in three straight lines here, it does not restrict to especially three.
[0020] Below, the example of an operation gestalt of the system configuration of a gamma correction is explained with reference to drawing 4 . This example of an operation gestalt changes a video signal into a digital signal, and performs the gamma correction mentioned above by data processing. Although this drawing shows one color of a color signal, processing same about other colors is performed.
[0021] After a video signal is changed into a 8-bit digital signal by A/D converter 1, it is inputted into the digital signal driver (DSD) 2. The inputted digital signal performs the gamma correction by the digital operation in the gamma correction section 5, after being adjusted, respectively by the gain controller 3 of the digital signal driver 2 interior, and the bright controller 4. Then, it is outputted as a 10-bit digital signal after adjustment by the limiter controller 6 and the black frame controller 7. The multiplier used in each processing section at this time is inputted as serial data from the digital signal driver 2 exterior, and is set up through serial I/F 8, and the counter/decoder 9.
[0022] After the 10-bit digital signal outputted from the digital signal driver 2 is changed into an analog signal by D/A converter 10, performs magnification and a reversal process with an analog amplifier 11 and performs a sample / hold processing, it is inputted into a liquid crystal panel 12, and displays an image.
[0023] As explained above, a video signal is displayed as an image which the gamma correction which was suitable for the liquid crystal panel with a digital operation was made, and was excellent in the vision target. In addition, in this system, all timing control is performed from a timing generator 13, and a setup of serial data is performed from a microcomputer (not shown). Moreover, the number of bits of I/O of the digital signal driver 2 and especially the number of the signal line between an analog amplifier 11 and a liquid crystal panel 12, i.e., the signal-line number of a liquid crystal panel 12, are not limited to the number mentioned above.
[0024] Below, the configuration of the gamma correction section 5 is explained with reference to drawing 5 . This configuration consists of selector block 20 which chooses the coefficient A of a formula (4), and B according to the level of the inputted video signal, and operation block 30 which inputs a video signal, a coefficient A, and B and calculates a formula (4). In addition, at this invention, the number of bits of an operation is the coefficient C 1 as which 8 bits and a coefficient A are inputted by 6 bits, and a coefficient B is inputted into it for an input signal by 10 bits and the comparator 21. And coefficient C 2 inputted into a comparator 22 Although 8 bits and an output signal were respectively made into 10 bits, it does not limit to especially these.
[0025] First, the configuration and actuation of the selector block 20 are explained. By the selector block 20 which chooses the multiplier corresponding to an input signal, they

are an input signal and a coefficient C 1. To a comparator 21, they are an input signal and a coefficient C 2. It is inputted into a comparator 22. This coefficient C 1 and C2 a1 in a formula (1) - a formula (3), and a2 It is equivalent to 8 bits of high orders. With comparators 21 and 22, they are an input signal, each coefficient C 1, and C2. It compares and they are X>=C1 and X>=C2. A flag signal "1" is outputted to a case, respectively, and "0" is outputted except it. the outputted signal -- respectively -- a 1-bit flip-flop (FF) -- it lets 23 and 24 pass and is inputted into decoders 25 and 26.

[0026] And when the output of LSB and a comparator 22 is considered for the output of a comparator 21 as MSB, It sets with the decoder 25 which chooses a coefficient A, and the decoder 26 which chooses a coefficient B. if the signal of the flip-flops 23 and 24 inputted is "00" -- a coefficient A 1 and B1 If it is "01", they are a coefficient A 2 and B-2. If it is "11", it is multiplier A3 and B3. After being chosen and preparing data with flip-flops 27 and 28, it is sent to the operation block 30.

[0027] Below, the configuration and actuation of the operation block 30 are explained. The input signal with which a gain adjustment and bright adjustment were performed is inputted into a multiplier 33 through the flip-flops 31 and 32 of 8 bit patterns. Moreover, the coefficient A chosen with the selector block 20 is also inputted into a multiplier 33. It is for doubling the number of stages of processing with the coefficient A of the selector block 20 with which letting two steps of flip-flops 31 and 32 pass is inputted into a multiplier 33 in an input signal.

[0028] And 4 bits of low order are omitted among 14 bits of the result of an operation, and 10 bits of high orders are outputted. For example, when a multiplier called A=01 0000 is set up, it becomes Y=AxX+B=X+B from a formula (4). Namely, 2 bits of high orders of a coefficient A will express one or more figures, 4 bits of low order will express less than one figure, and, as for a formula (4), an inclination can also express one or less straight line. After this result of an operation passes a flip-flop 34, it is inputted into an adder 35.

[0029] On the other hand, it is inputted into an adder 35 after the coefficient B chosen with the selector block 20 also passes a flip-flop 36. A flip-flop 36 is for making the timing in an adder 35 agree. The signal inputted into the adder 35 performs 10-bit +10-bit addition, and outputs ten of 11 bits of the result of an operation of low order. Then, it outputs to the limiter controller 6 shown in drawing 4 through a flip-flop 37, and as mentioned above, subsequent signal processing is performed and the signal by which the gamma correction was carried out is supplied to a liquid crystal panel. Graphic display which was visually excellent by this is realized.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] They are the applied voltage of a liquid crystal panel, and drawing of light transmittance.

[Drawing 2] It is drawing showing electrical-potential-difference conversion of the input signal with which the light transmittance of a liquid crystal panel becomes linear.

[Drawing 3] It is drawing for explaining straight-line approximation of the gamma correction concerning this invention.

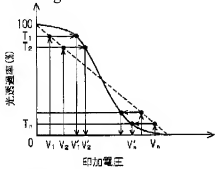
[Drawing 4] It is drawing of the system configuration of the gamma correction concerning this invention.

[Drawing 5] It is the block diagram of the gamma correction section concerning this invention.

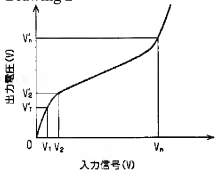
[Description of Notations]

1 -- An A/D converter, 2 -- A digital signal driver, 3 -- Gain controller, 4 [-- Black frame controller,] -- A bright controller, 5 -- The gamma correction section, 6 -- A limiter controller, 7 8 -- Serial 1/F, 9 -- A counter/decoder, 10 -- D/A converter, 11 [-- 21 A selector block 22 / -- A comparator, 23, 24, 27, 28, 31, 32, 34 36, 37 / -- 25 A flip-flop, 26 / -- A decoder, 33 / -- A multiplier, 35 / -- Adder] -- An analog amplifier, 12 -- A liquid crystal panel, 13 -- A timing generator, 20

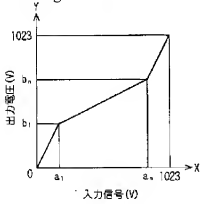
Drawing 1



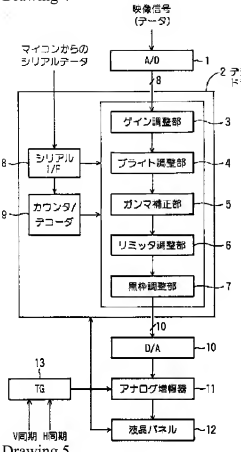
Drawing 2



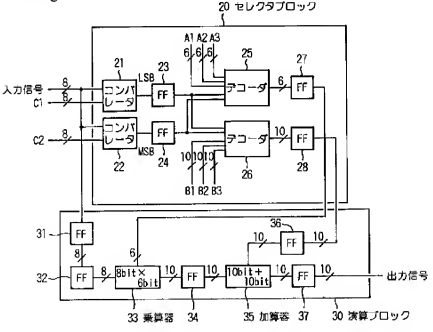
Drawing 3



Drawing 4



Drawing 5



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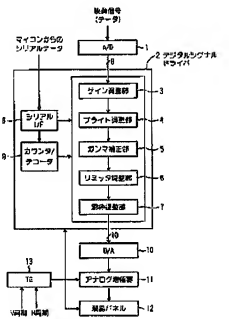
(54)【発明の名称】　ガンマ補正装置

(57)【要約】
【課題】　急峻なガンマ特性を有する表示デバイスのガンマ補正に用いて好適なガンマ補正装置を提供する。
【解決手段】　表示デバイスのガンマ特性曲線を複数の直線で近似し、その直線を表す１次式Ｙ＝Ａ×Ｘ＋Ｂの係数Ａ，Ｂを各直線毎に求め、この式に基づいて入力信号レベルを変換する。入力した映像信号はＡ／Ｄコンバータ１でデジタル化され、ゲイン調整部３，ブライト調整部４でそれぞれ調整された後、ガンマ補正部５において、そのレベルが、近似した直線のいずれの直線に対応しているかを判別し、その対応する１次式に基づいて入力映像信号レベルを演算し補正する。その後、リミッタ調整部６，黒検調整部７で調整後、Ｄ／Ａコンバータ１０でアナログ信号に変換され、アナログ増幅器１１で増幅、および反転処理を行い表示デバイスである液晶パネル１２に入力されて映像を表示する。



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【特許請求の範囲】

【請求項１】　ガンマ特性曲線を複数の直線で近似する直線近似手段と、

前記近似した各々の直線を表す１次式の各係数を決定する係数決定手段と、

前記近似した、隣接する直線の連接位置を求める算出手段と、

入力した映像信号レベルが前記近似した直線のいずれの直線に対応しているかを判別する判別手段と、

前記判別された直線に基づいて前記映像信号レベルを変換する演算手段とを具備したことを特徴とするガンマ補正装置。

【請求項２】　ガンマ特性曲線を複数の領域に分割する分割手段と、

前記分割された領域のガンマ特性曲線を、隣接する領域の境界で連接する直線で近似する直線近似手段と、

前記近似した各々の直線を表す１次式の各係数を決定する係数決定手段と、

入力した映像信号レベルが前記分割した領域のいずれの領域に対応しているかを判別する判別手段と、

前記判別された領域のガンマ特性曲線に対して近似した直線に基づいて前記映像信号レベルを変換する演算手段とを具備したことを特徴とするガンマ補正装置。

【請求項３】　ガンマ特性曲線を複数の領域に分割する前記分割手段を、外部操作により分割位置の設定ができるように構成したことを特徴とする、請求項２に記載のガンマ補正装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明はガンマ補正装置に関し、特に急峻なガンマ特性曲線を有する液晶パネル等のガンマ補正に用いて好適なガンマ補正装置に関する。

【０００２】

【従来の技術】近年の電子機器の小型化、携帯化等に伴い薄型で消費電力の少ない液晶パネルが表示装置として盛んに用いられるようになってきている。液晶パネルはその特性から極めて急峻なガンマ特性を有していて、視覚的に良好な状態で映像を表示するために、入力信号をその入力レベルに応じてレベル変換するガンマ補正を行った後、液晶パネルに入力している。

【０００３】このガンマ補正にはバイポーラのアナログアンプを用い、入力電圧に応じた増幅率で増幅して補正する方法がある。この場合、液晶パネルのように急峻なガンマ特性を有している表示デバイスに対してはアンプの増幅率を大きくすることが必要である。しかしながら、一般にアナログアンプは増幅率を増大すると周波数特性とＳ／Ｎ比の悪化を伴うものであり、また、極めて急峻なガンマ特性に対しては、これを補正するための十分な増幅率を確保することは困難であった。

【０００４】また、ガンマ補正の他の方法として記憶素子、例えばＲＡＭに入力レベルに対する出力レベルを記憶させた変換テーブルを用いる方法がある。しかしながら、この場合は表示デバイスの特性ごとに変換テーブルを作成する必要があり、また、記憶エリアを大きく占めることになっていた。

【０００５】

【発明が解決しようとする課題】従って本発明は、急峻なガンマ特性を有している表示デバイスに対して、周波数特性とＳ／Ｎ比の悪化を生じることなく階調をより正確に表現し、また、任意のガンマ補正曲線を容易に設定することができるガンマ補正装置の提供を目的とする。

【０００６】

【課題を解決するための手段】請求項１の記載によれば、ガンマ特性曲線を複数の直線で近似する直線近似手段と、前記近似した各々の直線を表す１次式の各係数を決定する係数決定手段と、前記近似した、隣接する直線の直線位置を求める算出手段と、入力した映像信号レベルが前記近似した直線のいずれの直線に対応しているかを判別する判別手段と、前記判別された直線に基づいて前記映像信号レベルを変換する演算手段とを具備したガンマ補正装置を構成する。

【０００７】この構成により、ガンマ補正曲線を複数の直線で近似してデジタルによる演算で映像信号を高い増幅率で増幅することができ、急峻なガンマ特性を有する表示デバイスに対応して正確にガンマ補正をすることができる。また、デジタル信号処理の後、アナログ信号に戻すのでガンマ補正による周波数特性とＳ／Ｎが悪化することを防止することが可能となる。

【０００８】請求項２の記載によれば、ガンマ特性曲線を複数の領域に分割する分割手段と、前記分割された領域のガンマ特性曲線を、隣接する領域の境界で直線で近似する直線近似手段と、前記近似した各々の直線を表す１次式の各係数を決定する係数決定手段と、入力した映像信号レベルが前記分割した領域のいずれの領域に対応しているかを判別する判別手段と、前記判別された領域のガンマ特性曲線に対して近似した直線に基づいて前記映像信号レベルを変換する演算手段とを具備したガンマ補正装置を構成する。

【０００９】この構成により、ガンマ補正曲線を分割した領域毎に直線で近似してデジタルによる演算で映像信号を高い増幅率で増幅することができ、急峻なガンマ特性を有する表示デバイスに対応して正確にガンマ補正をすることができる。また、デジタル信号処理の後、アナログ信号に戻すのでガンマ補正による周波数特性とＳ／Ｎが悪化することを防止することが可能となる。

【００１０】請求項３の記載によれば、請求項２に記載のガンマ補正装置において、ガンマ特性曲線を複数の領域に分割する分割手段を、外部操作により分割位置の設定ができるように構成する。

【００１１】ガンマ特性曲線を任意の領域に外部操作に

より分割することが可能となる。

【0012】

【発明の実施の形態】本発明の実施の形態について図1ないし図5を参照して説明する。図1は液晶パネルの印加電圧と光透過率の関係を示す図であり、図2は液晶パネルの光透過率がリニアとなる入力信号の電圧変換を示す図である。図3は本発明に係わるガンマ補正の直線近似について説明するための図である。また、図4は本発明に係わるガンマ補正のシステム構成の図であり、図5はその ガンマ補正部の構成を示す図である。尚、以下の説明においては表示デバイスとして液晶パネルを対象としているが、本発明を他の表示デバイスに適用してもよいことは当然である。

【0013】液晶パネルの印加電圧と光透過率の関係は図1の実線に示すように、印加電圧に対して光透過率の変化が ゆるやかな部分と急峻な部分とからなるガンマ特性を有している。このようなガンマ特性に映像信号をそのまま入力すると不自然な画像が表示されることになる。

【0014】さて、このガンマ特性のもとで印加電圧にリニアな図1の破線に乗った画像表示をしようとする。まず、T_1の透過率を得ようとすると破線上でV_1の電圧は実線上では$V_1'\cdots V_n$はV。'となる。即ち、図2に示すように横軸の入力信号に対して縦軸の出力信号となるように電圧変換が成され、この変換された電圧を前述したガンマ特性を有する液晶パネルに入力することにより、元来の映像信号に対してリニアな表示が行うことができる。

*【0015】この入力信号のレベル変換は、従来はアナログアンプや変換テーブルが用いられて行われ、その開題も既に述べたところである。尚、視覚的効果の観点から、図1の破線は適度な変換が行える曲線であってもよい。

【0016】本発明においては、この変換を図3に示すように、図2の変換曲線（以下、「ガンマ補正カーブ」と称す）を数つの直線で近似して、この直線に基づいて演算して変換しようとするものである。それぞれの直線は隣接する領域の境界で連接するように決定されている。尚、この直線は指定した直線本数内でガンマ特性と比較して誤差が最小となるように演算により自動的に決定されてもよく、また、外部指示による分割された領域ごとに最適な直線を決定してもよい。

【0017】つぎに、この近似した直線の性質について説明する。例えば図3に示すようにガンマ補正カーブは入力信号が0～a_1と、a_1～a_2と、a_2～1023との3つの直線で近似されているものとする。ここで1023とは入力信号を1023の等間隔で分割したことを示しており、特にこの数値に限定されるものではない。出力電圧の1023についても同様である。

【0018】これら直線による変換は入力信号0に対し出力電圧は0であり、入力信号a_1に対し出力電圧はb_1であり、入力信号a_2に対し出力電圧はb_2であり、入力信号1023に対し出力電圧は1023であるので、それぞれの直線は順に次の式（1）、式（2）、式（3）で表すことができる。

$$Y = b_1 / a_1 \times X \quad (1)$$

$$Y = (b_2 - b_1) / (a_2 - a_1) \times (X - a_1) + b_1 \quad (2)$$

$$Y = (1023 - b_2) / (1023 - a_2) \times (X - a_2) + b_2 \quad (3)$$

これらの式は一般に式（4）で表される。

$$Y = A \times X + B \quad (4)$$

【0019】従って、各領域における係数A，Bを決定し、その領域の入力信号をその領域の直線の数式のXに代入し、Yを求めることでその入力信号に対するガンマ補正された信号を得ることができる。尚、ここでは直線3本でガンマ補正カーブを近似したが、特に3本に限るものではない。

【0020】つぎに、ガンマ補正のシステム構成の実施形態例について図4を参照して説明する。本実施形態例は映像信号をデジタル信号に変換し、演算処理により上述したガンマ補正を行うものである。同図ではカラー信号の1色について示しているが、他の色についても同様の処理を行う。

【0021】映像信号はA／Dコンバータ1で8ビットのデジタル信号に変換されたあと、デジタルシグナルドライバ（DSD）2に入力される。入力されたデジタル信号はデジタルシグナルドライバ2内部のゲイン調整部3、ブライト調整部4でそれぞれ調整された後、ガンマ補正部5においてデジタル演算によるガンマ補正を行う。その後、リミッタ調整部6、具持調整部7で調整後、10ビットのデジタル信号として出力される。この時の各処理部で用いられる係数等はデジタルシグナルドライバ2外部からシリアルデータとして入力され、シリアル1／F8、カウンタ／デコーダ9を通して設定される。

【0022】デジタルシグナルドライバ2から出力された10ビットのデジタル信号は、D／Aコンバータ10でアナログ信号に変換され、アナログ増幅器11で増幅、および反転処理を行いサンプル／ホールド処理を行った後、液晶パネル12に入力されて映像を表示する。

【0023】以上説明したように、映像信号はデジタル演算により液晶パネルに適したガンマ補正がなされて視覚的に優れた映像として表示される。尚、本システムにおいて全てのタイミング制御はタイミングジェネレータ13から行い、シリアルデータの設定はマイコン（図示

せず）から行う。また、デジタルシグナルドライバ２の入出力のビット数、アナログ増幅器１１と液晶パネル１２の間の信号線の本数、即ち、液晶パネル１２の信号線本数は特には上述した本数に限定するものではない。

【００２４】つぎに、ガンマ補正部５の構成について図５を参照して説明する。この構成は入力した映像信号のレベルに応じて式（４）の係数Ａ，Ｂを選択するセレクタブロック２０と、映像信号と係数Ａ、Ｂを入力して式（４）の演算を行う演算ブロック３０とから構成されている。尚、本発明では演算のビット数は入力信号を８ビット、係数Ａを６ビット、係数Ｂを１０ビット、コンパレータ２１に入力される係数Ｃ，およびコンパレータ２２に入力される係数Ｃ，を各々８ビット、出力信号を１０ビットとしたが、特にこれらに限定するものではない。

【００２５】まず、セレクタブロック２０の構成と動作について説明する。入力信号に対応した係数を選択するセレクタブロック２０では、入力信号と係数Ｃ，がコンパレータ２１に、入力信号と係数Ｃ，がコンパレータ２２に入力される。この係数Ｃ，，Ｃ，は式（１）～式（３）中のａ，、ａ，の上位８ビットに相当する。コンパレータ２１、２２では入力信号と各係数Ｃ，、Ｃ，とを比較し、Ｘ≧Ｃ，、Ｘ≧Ｃ，の場合にそれぞれフラグ信号「１」を出力し、それ以外は「０」を出力する。出力された信号はそれぞれ１ビットのフリップフロップ（ＦＦ）２３、２４を通して、デコーダ２５、２６に入力される。

【００２６】そして、コンパレータ２１の出力をＬＳＢ、コンパレータ２２の出力をＭＳＢとして考えたとき、係数Ａを選択するデコーダ２５と係数Ｂを選択するデコーダ２６とおいて、入力されるフリップフロップ２３、２４の信号が「００」であれば係数Ａ，，Ｂ，が、「０１」であれば係数Ａ，，Ｂ，が、「１１」であれば係数Ａ，，Ｂ，が選択されて、フリップフロップ２７、２８でデータが揃えられた後、演算ブロック３０に送られる。

【００２７】つぎに、演算ブロック３０の構成と動作について説明する。ゲイン調整とブライト調整の行われた入力信号は８ビット構成のフリップフロップ３１と３２を通して乗算器３３に入力される。また、セレクタブロック２０で選択された係数Ａも乗算器３３に入力される。入力信号を２段のフリップフロップ３１、３２を通すのは、乗算器３３に入力されるセレクタブロック２０の係数Ａとの処理の段数を合わせるためである。

【００２８】そして演算結果の１４ビットの内、下位４ビットを切り捨て、上位１０ビットを出力する。例えば、Ａ＝０１＿００００という係数を設定したとき、式（４）から、

Ｙ＝Ａ×Ｘ＋Ｂ＝Ｘ＋Ｂ

となる。即ち、係数Ａの上位２ビットは１以上の数字を、下位４ビットは１未満の数字を表すことになり、式（４）は結さが１以下の直線も表現することができる。この演算結果はフリップフロップ３４を通過した後、加算器３５に入力される。

【００２９】一方、セレクタブロック２０で選択された係数Ｂもフリップフロップ３６を通過した後、加算器３５に入力される。フリップフロップ３６は加算器３５でのタイミングを合致させる為めである。加算器３５に入力された信号は１０ビット＋１０ビットの加算を行い、演算結果の１１ビットのうち、下位の１０ビットを出力する。その後、フリップフロップ３７を通して図４に示すリミッタ調整部６へ出力し、崩述したようにその後の信号処理が行われ、ガンマ補正された信号が液晶パネルに供給される、これにより視覚的に優れた映像表示を実現する。

【００３０】

【発明の効果】以上の説明から明らかなように、本発明のガンマ補正装置によればデジタルによる演算で映像信号を高い増幅率で増幅することができるため、映像信号の階調をより正確に表現できる。また、デジタル信号処理の後、アナログ信号に戻すのでガンマ補正による漏洩散特性とＳ／Ｎが悪化することを防止することが可能となる。さらに、デジタルによる演算の係数を外部から任意に設定することができるので種々の特性の液晶パネルに適用することが可能である。

【図面の簡単な説明】

【図１】　液晶パネルの印加電圧と光透過率の図である。

【図２】　液晶パネルの光透過率がリニアとなる入力信号の電圧変換を示す図である。

【図３】　本発明に係わるガンマ補正の直線近似について説明するための図である。

【図４】　本発明に係わるガンマ補正のシステム構成の図である。

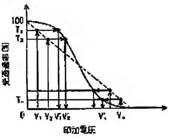
【図５】　本発明に係わるガンマ補正部のブロック図である。

【符号の説明】

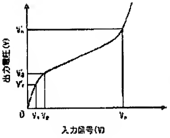
１…Ａ／Ｄコンバータ、２…デジタルシグナルドライバ、３…ゲイン調整部、４…ブライト調整部、５…ガンマ補正部、６…リミッタ調整部、７…黒検調整部、８…シリアル１／Ｆ、９…カウンタ／デコーダ、１０…Ｄ／Ａコンバータ、１１…アナログ増幅器、１２…液晶パネル、１３…タイミングジェネレータ、２０…セレクタブロック、２１、２２…コンパレータ、２３，２４，２７，２８，３１，３２，３４，３６，３７…フリップフロップ、２５，２６…デコーダ、３３…乗算器、３５…加算器

Page 1 of 1

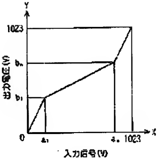
【図1】



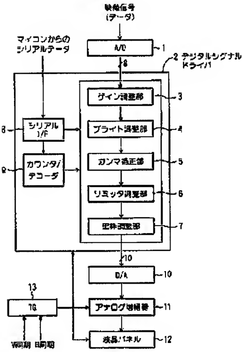
【図2】



【図3】

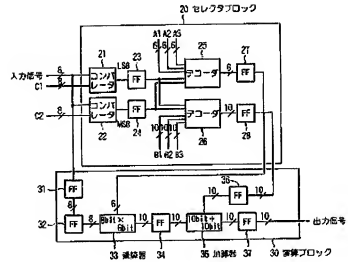


【図4】



http://www4.ipdl.ncipi.go.jp/tjcontentdben.ipdl?N0000=21&N0400=image/gif&N0401=/... 9/25/2006

【図5】


20 セレクタブロック
A1 A2 A3
B1 B2 B3
入力信号
C1
C2
コンパレータ
FF
デコーダ
出力信号
33 減算器
34
35 加算器
37
30 演算ブロック